

**What Is Claimed Is:**

1           1.       A method for generating a complementary mask data for  
2 use in a photolithographic process, the method comprising:  
3           receiving a first mask data corresponding to the complementary  
4 mask;  
5           identifying a plurality of critical openings in the first mask data;  
6           determining a threshold intensity for the plurality of critical openings  
7 during the photolithographic process;  
8           modifying the plurality of critical openings such that each of the  
9 plurality of critical openings will provide at least the threshold intensity  
10 during the photolithographic process.

1           2.       The method of claim 1, wherein modifying comprises:  
2           increasing the area of at least one cut.

1           3.       The method of claim 2, wherein:  
2           the increase in area is substantially proportional to the difference  
3 between:  
4           a maximum intensity of the opening prior to increasing; and  
5           said threshold intensity.

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1           4.       The method of claim 2, wherein:  
2           the increase in area is accomplished by moving at least one edge  
3 that does not abut any feature to be formed in an integrated circuit by use  
4 of the phase shifting mask.

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1           5.       The method of claim 1 further comprising:

2 identifying openings that have areas too small to generate a  
3 predetermined maximum intensity of radiation in an aerial image of the  
4 complementary mask;  
5 wherein said modifying is performed on said identified openings.

1 6. The method of claim 5, wherein identifying the openings  
2 comprises:  
3 modeling exposures through the phase shifting mask and the  
4 complementary mask to produce a result; and  
5 examining the result.

1 7. The method of claim 5, wherein the modifying comprises  
2 simplifying the mask shape.

1 8. An electromagnetic waveform carrying instructions that  
2 when executed by a computer cause the computer to perform a method  
3 for change a complementary mask to be used in fabricating an integrated  
4 circuit, wherein the complementary mask uses openings to clear  
5 unwanted regions left by use of a phase shifting mask, the method  
6 comprising:  
7 receiving a first mask data corresponding to the complementary  
8 mask;  
9 identifying a plurality of critical openings in the first mask data;  
10 determining a threshold intensity for the plurality of critical openings  
11 during the photolithographic process; and  
12 assisting a user in modifying the plurality of critical openings such  
13 that each of the plurality of critical openings will provide at least the  
14 threshold intensity during the photolithographic process.

1           9.     The electromagnetic waveform of claim 8, wherein modifying  
2     comprises increasing the area of at least one cut.

1           10.    The electromagnetic waveform of claim 9, wherein the  
2     increase in area is substantially proportional to the difference between:  
3                 an intensity of the opening prior to increasing; and  
4                 said threshold intensity.

1           11.    The electromagnetic waveform of claim 9, wherein:  
2             the increase in area is accomplished by moving at least one edge  
3     that does not abut any feature to be formed in an integrated circuit by use  
4     of the phase shifting mask.

1           12.    A complementary mask to be used in fabricating an  
2     integrated circuit, wherein the complementary mask uses openings to  
3     clear unwanted regions left by use of a phase shifting mask, wherein the  
4     complementary mask is formed by a method comprising:  
5             receiving a first mask data corresponding to the complementary  
6     mask;  
7             identifying a plurality of critical openings in the first mask data;  
8             determining a threshold intensity for the plurality of critical openings  
9     during the photolithographic process; and  
10            assisting a user in modifying the plurality of critical openings such  
11     that each of the plurality of critical openings will provide at least the  
12     threshold intensity during the photolithographic process.

1           13.    The complementary mask of claim 12, wherein said critical  
2   openings on the complementary mask prior to said method may not clear  
3   the unwanted regions and said critical openings subsequent to said  
4   method have enlarged areas.

1           14.    The complementary mask of claim 13, wherein the  
2   enlargement of area is substantially proportional to the difference  
3   between:

4                   a maximum intensity of an opening prior to enlargement;  
5   and  
6                   said threshold intensity.

1           15.    The complementary mask of claim 13, wherein the increase  
2   in area is accomplished by moving at least one edge that does not abut  
3   any feature to be formed in an integrated circuit by use of the phase  
4   shifting mask.

1           16.    An apparatus for using an exposure through a  
2   complementary mask to improve an exposure through a phase shifting  
3   mask used in fabricating an integrated circuit, comprising:  
4           a receiving mechanism configured to receive a first mask data  
5   corresponding to the complementary mask;  
6           a identifying mechanism configured to identify a plurality of critical  
7   openings in the first mask data; and  
8           a mechanism configured to assist a user in modifying the plurality  
9   of critical openings such that each of the plurality of critical openings will  
10   provide at least a predetermined threshold intensity during the  
11   photolithographic process.

1           17.    The apparatus of claim 16 wherein the modifying  
2 mechanism comprises an area enlargement mechanism.

1           18.    The apparatus of claim 17 wherein the area enlargement  
2 mechanism comprises a differencing mechanism configured to determine  
3 the difference between:  
4                   a maximum intensity of a opening prior to enlargement; and  
5                   said threshold intensity.

1           19.    The apparatus of claim 17 wherein the area enlargement  
2 mechanism comprises an edge movement mechanism configured to  
3 move at least one edge that does not abut any feature to be formed in an  
4 integrated circuit by use of the phase shifting mask.

1           20.    A means for using an exposure through a complementary  
2 mask to improve an exposure through a phase shifting mask used in  
3 fabricating an integrated circuit, comprising:  
4                   means for receiving a first mask data corresponding to the  
5 complementary mask;  
6                   means for identifying a plurality of critical openings in the first  
7 mask;  
8                   means for receiving a predetermined threshold intensity for the  
9 plurality of critical openings to be effective during the photolithographic  
10 process; and  
11                  means for modifying the plurality of critical openings such that each  
12 of the plurality of critical openings will provide at least the threshold  
13 intensity during the photolithographic process.

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1           21.    A complementary mask to be used in fabricating an  
2 integrated circuit, wherein the complementary mask uses openings to  
3 clear unwanted regions left by use of a phase shifting mask, and at least  
4 one opening in the complementary mask has fewer sides than a prior  
5 version of said opening formed by an optical proximity correction  
6 technique.

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1           22.    The complementary mask of Claim 21 wherein:  
2           said one opening comprises at least one rectangle; and  
3           said prior version of said opening comprises at least one polygon.

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